Claims

1. An optical instrument for fluorescence analysis of many colors from a target having fluorescent material comprising,

a plurality of lasers of different wavelengths which generate a plurality of beams, said beams impinging upon fluorescent material,

a light collector to collect fluorescent light from said fluorescent material into an output transfer beam,

a plurality of dichroic mirrors arranged to receive the transfer beam from the light collector, said dichroic mirrors having a partially reflective surface splitting the light into a transfer leg and a transmitted detector leg, a majority of the dichroic mirrors receiving light from the partially reflective surface of another dichroic mirror, and

a plurality of detectors, with one detector being associated with a dichroic mirror, to receive light from the detector leg thereof.

2. The apparatus of claim 1 wherein the plurality of dichroic mirrors and the plurality of detectors is divided into a multiplicity of groups of mirrors and detectors and light from the light collector is directed into a multiplicity of fibers, each fiber delivering light to a group of mirrors and detectors.

3. The apparatus of claim 2 wherein each fiber is associated with collected light from a selected laser.

4. The apparatus of claim 2 wherein each of the groups of mirrors and detectors is arranged in a cluster.

5. The apparatus of claim 4 wherein each cluster lies in a plane mounted parallel to another cluster.

6. The apparatus of claim 1 wherein said light collector is an immersion objective lens.

7. An optical instrument for fluorescence analysis of many colors from a target substance comprising,

a plurality of beam sources having beams impinging upon fluorescent target material thereby producing fluorescent light,

a plurality of optical fibers corresponding in number to the plurality of beam sources, the fibers having associated optics collecting the fluorescent light, each fiber having an input terminal and an output terminal with an optical axis therebetween and projecting outwardly from each output terminal,

a plurality of arrays of dichroic mirrors, with at least one dichroic mirror in each array disposed along each projected optical axis thereby receiving light from a fiber output terminal, and

a plurality of detectors associated with each mirror array, with at least one detector associated with each mirror, the mirrors and detectors arranged in a single enclosure defining a cluster, thereby isolating the fluorescent light signatures of one cluster from another.

8. An optical instrument for fluorescence analysis comprising,

a holder supporting fluorescent targets,

a plurality of lasers directing beams to impinge upon the fluorescent targets thereby generating fluorescent light,

a light collector positioned to collect fluorescent light from targets in a manner maintaining separation of fluorescent light output for each incident beam,

a plurality of optical fibers, each fiber having an input end receiving output fluorescent light from the light collector and an output end directing said fluorescent light outwardly along a projected optical axis,

a series of dichroic mirrors associated with each projected optical axis, separating fluorescent light into output beams of constituent wavelengths,

a series of detectors intercepting the output beams of constituent wavelengths with a detector associated with each dichroic mirror, with a number of mirrors and detectors forming a cluster wherein light from only one fiber is in each cluster, a group of clusters associated with all of the optical axes.

9. The apparatus of claim 8 wherein said group of clusters is formed in the same horizontal plane.

10. The apparatus of claim 8 wherein said group of clusters is stacked.

11. The apparatus of claim 8 wherein said group of clusters is arranged in a rack.

12. The apparatus of claim 8 wherein said fibers correspond in number to the plurality of lasers.

13. The apparatus of claim 8 wherein said detectors are photomultiplier tubes.

14. The apparatus of claim 8 wherein said detectors are semiconductors.

15. The apparatus of claim 8 wherein said detectors have variable sensitivity over a detector area, the detectors generating an electrical signal representing the variable sensitivity of the detectors, the detectors and an intercepted beam being relatively moveable, whereby a selected sensitivity may be obtained.

16. The apparatus of claim 15 further defined by a series of focusing lenses associated with each dichroic mirror intercepting the output beams of constituent colors and directing light therefrom to (i) the detectors of variable zonal sensitivity and (ii) a series of focus lenses intercepting the output beams of constituent colors and directing light to the detectors of variable zonal sensitivity wherein relative motion of each focus lens and detector varies the sensitivity of the generated electrical signal.

17. The apparatus of claim 8 wherein said detectors are arranged in a polygonal array.

18. The apparatus of claim 8 wherein the number of detectors exceeds 5.

19. An optical instrument of the type having one or more input beams impinging upon fluorescent material to be analyzed with fluorescent light collected by a light collector and formed into at least one output beam for analysis, the output beam having a projected optical axis and a plurality of spaced apart dichroic mirrors disposed along the projected optical axis in a manner separating light at each mirror into a reflected beam and a transmitted beam, wherein one of the reflected and transmitted beams is a transfer leg carrying the beam further to the next dichroic mirror and another leg carrying light to a detector wherein the improvement comprises,

an arrangement of the plurality of dichroic mirrors wherein a majority of the dichroic mirrors receives light from a reflected beam coming from another dichroic mirror.

20. The apparatus of claim 19 wherein the number of dichroic mirrors is at least four.

21. The apparatus of claim 19 wherein all of the dichroic mirrors except one receive light from a reflected beam coming from a dichroic mirror.

22. The apparatus of claim 19 wherein all of the dichroic mirrors except two receive light from a reflected beam coming from a dichroic mirror.

23. An optical instrument for fluorescence analysis of many colors comprising,

a light transmissive holder supporting fluorescent target material,

a plurality of lasers of different colors having closely spaced beams illuminating said target material,

a light collector means for forming beams of fluorescent light with spatial separation, one beam associated with each laser,

a plurality of optical fibers, each fiber receiving light of a different color from one of the beams associated with each laser,

a plurality of detector arrays, each array forming a cluster receiving light from a fiber, each cluster having color decimation means for separating and detecting colors received from the associated detector cluster.

24. The apparatus of claim 23 wherein each color decimation means with a detector array has a plurality of beam splitters arranged in cascade relationship, at least one detector associated with each beam splitter, with a first beam splitter positioned to receive light from an associated fiber, the first beam splitter and most cascaded beam splitters having a reflective transfer leg of light and a transmitted transfer leg of light directed to an associated detector.

25. The apparatus of claim 24 wherein the detectors are arranged in a polygonal pattern having a first circumference.

26. The apparatus of claim 25 wherein the beam splitters are arranged in a polygonal pattern having a second circumference smaller than the first circumference.

27. The apparatus of claim 26 wherein a plurality of filters is arranged in a polygonal pattern, with a filter associated with each detector, the polygonal circumference of the filters greater than the circumference of the beam splitters but less than the circumference of the detectors.

28. The apparatus of claim 24 wherein each beam splitter is mounted in a removeable aligning holder.

29. The apparatus of claim 23 wherein each cluster receives light from the light collector by means of one of said optical fibers, the light in each optical fiber associated with fluorescence from a different laser.

30. The apparatus of claim 23 wherein said light collector means is a microscope immersion objective type of lens.

31. The apparatus of claim 30 wherein said lens has a numerical aperture greater than one.

32. The apparatus of claim 24 wherein the reflective transfer legs cross each other.

33. The apparatus of claim 24 wherein the reflective transfer legs do not cross each other.

34. An apparatus for self-aligning replacement of lenses and mirrors in specified positions comprising,

a first block positioned along an optical axis having an aperture accommodating the optical axis and having a flat side and a spring-loaded movable registration member, and

a second block movable relative to the first block and having a desired lens or mirror mounted therein, the second block having a flat side facing the flat side of the first block and having a fixed registration member, with the spring-loaded movable registration member of the first block engaging the fixed registration member of the second block whereby the desired lens or mirror is aligned along the optical axis.